

# Claims

What is claimed is:

1. A method for aggregating network file protocol transactions in a network system, the method comprising the steps of:

receiving a first frame of a first message belonging to a first transaction, the first frame containing a first file protocol header and a first data, the first transaction initiated by a first client computer;

based on information in the first file protocol header, selecting a first set of file servers to participate in handling the first transaction;

sending a second frame to a first server from the first set of file servers, the second frame containing a second file protocol header and a portion of the first data, the second file protocol header being derived from the first file protocol header.

2. The method in claim 1 further comprising the steps of:

receiving a third frame from said first server, the third frame containing a third file protocol header;

sending a fourth frame to the first client computer, the fourth frame containing a fourth file protocol header, the fourth file protocol header being derived from the third file protocol header.

3. The method in claim 1 further comprising the step of sending a third frame to a second server from the first set of file servers, the third frame containing a third file protocol header and a portion of the first data, the third file protocol header being derived from the first file protocol header.

4. The method in claim 3 further comprising the steps of:

receiving a fourth frame from said first server, the fourth frame containing a fourth file protocol header;

receiving a fifth frame from said second server, the fifth frame containing a fifth file protocol header;

creating a response file protocol header, derived from the fourth file protocol header and from the fifth file protocol header;

sending a sixth frame to the first client computer, the sixth frame containing the response file protocol header.

5. A method for aggregating network file protocol transactions in a network system, the method comprising the steps of:

receiving a first frame of a first message belonging to a first transaction, the first frame containing a first file protocol header and a first data, the first transaction initiated by a first client computer;

based on information in the first file protocol header, selecting a first set of file servers to participate in handling the first transaction;

sending a second frame to a first server from the first set of file servers, the second frame containing a second file protocol header and a portion of the first data, the second file protocol header being derived from the first file protocol header;

receiving a third frame of the first message, the third frame containing a second data;

sending a fourth frame to a second server from the first set of file servers, the fourth frame containing a third file protocol header and a portion of the second data.

6. The method of claim 5 further comprising the steps of:

receiving a fifth frame from said first server, the fifth frame containing a fourth file protocol header;

receiving a sixth frame from said second server, the sixth frame containing a fifth file protocol header;

sending a seventh frame to the first client computer, the seventh frame containing a sixth file protocol header, the sixth file protocol header being derived from the fourth file protocol header and from the fifth file protocol header.

7. The method of claim 5 further comprising the steps of:

sending a fifth frame to a third server from the first set of file servers, the fifth frame containing a modified first file protocol header and a portion of the first data,

sending a sixth frame to a fourth server from the first set of file servers, the sixth frame containing a file protocol header and a portion of the second data.

8. A method for aggregating network file protocol transactions in a network system, the method comprising the steps of:

receiving a first frame belonging to a first transaction, the first frame containing a first file protocol header, the first transaction initiated by a first client computer;

based on information in the first file protocol header, selecting a first set of file servers to participate in handling the first transaction;

sending a second frame to a first server from the first set of file servers, the second frame containing a modified first file protocol header;

sending a third frame to a second server from the first set of file servers, the second frame containing a modified first file protocol header.

9. The method of claim 6 further comprising the steps of:

receiving a fourth frame from said first server, the fourth frame containing a second file protocol header and a first data;

receiving a fifth from said second server, the fifth frame containing a third file protocol header and a second data;

creating a response file protocol header, based on information in the second file protocol header and on information in the third file protocol header;

sending a sixth frame to the first client computer, the sixth containing the response file protocol header and a portion of the first data.

10. A method for aggregating file systems by switching and aggregating network file protocol transactions.

11. A method for aggregating file systems, the method comprising the steps of:

aggregating the namespace of multiple file systems and presenting them as a single namespace;

aggregating directories of multiple file systems by presenting them as a single directory;

aggregating file objects of multiple file systems by presenting them as a single file object;

aggregating the file data of files in multiple file systems by presenting it as data of a single file.

12. The method in claim 11 further comprising the step of aggregating the concurrency resolution mechanisms provided the each of the multiple file systems to implement a concurrency resolution mechanism for the aggregated file system.

13. A method for storing files in a network storage system, the method comprising the steps of:

aggregating the namespace of multiple file systems and presenting them as a single namespace;

aggregating directories of multiple file systems by presenting them as a single directory;

aggregating file objects of multiple file systems by presenting them as a single file object;

aggregating the file data of files in multiple file systems by presenting it as data of a single file.

14. A method for scaling switches that switch client-server protocols, the method comprising the steps of:

implementing the switch so that it appears as a client to servers;

implementing the switch so that it appears as a server to clients;

using the ability of servers to arbitrate between multiple clients in order to arbitrate between the switches.

15. A method for scaling a storage network functioning under a client-server network protocol, the network comprising clients and servers, the network protocol providing an ability of the servers to arbitrate requests from multiple concurrent clients, the servers implementing the server side of the network protocol, the clients implementing the clients side of the network protocol, the method comprising the steps of:

inserting a plurality of switches between the clients and the servers, each of the switches providing the server side of the network protocol when communicating with clients, and each of the switches providing the client side of the network protocol when interacting with servers;

using the ability of servers to arbitrate between multiple concurrent clients in order to arbitrate between the switches.

16. In a computer network that includes a plurality of client computers and a plurality of server computers, an apparatus for switching and aggregating files, the apparatus being interconnected among at least one of the plurality of client computers and at least one of the plurality of server computers, wherein the file switch computer:

receives a message that includes data and a file protocol header in a first message frame;

determines, in a manner based upon the file protocol header and independent of the message data, to which at least one network node the message is to be forwarded;

derives a modified file protocol header in a manner based upon the determination;  
and

forwards the modified file protocol header and the message data.

17. The apparatus according to claim 16 wherein, when a plurality of concurrent messages are received by the file switch computer, only one of the concurrent messages results in a successful request.

18. In a computer network including a plurality of client computers and a plurality of server computers, an apparatus providing file switching and file aggregating functionality among at least one client computer and at least one server computer, the apparatus appearing as a client computer to the at least one server computer and as a server computer to the at least one client computer.

19. A switched file system for handling networked file data, the system comprising:  
a plurality of client computers;  
a plurality of server computers;  
at least one file switch, the file switch being capable of switching file messages from a client computer to a plurality of server computers.

20. A switched file system for handling networked file data, the system comprising:  
a plurality of client computers;  
a plurality of server computers;  
at least one file switch, the file switch being capable of aggregating file messages from a plurality of servers to a client computer.

21. In a computer network including a plurality of servers, a file switch, and a plurality of clients, a file directory created and maintained among the plurality of servers according to a process comprising:

a first file switch receiving a file protocol message from a client, the message including a file header in a first packet of the message;

the first file switch analyzing the file header; and

the first file switch determining, according to a plurality of message handling rules, how to divide the message among the plurality of servers.

22. The file directory created and maintained according to the process of claim 21, in which the network further includes a plurality of switches.

23. The file directory created and maintained according to the process of claim 22, in which the message handling rules are shared by a second file switch.

24. The file directory according to claim 23, wherein the plurality of message handling rules are updated in the first and second file switch through file messages received from at least one file server.

25. An apparatus providing network use data, the apparatus comprising, in a computer network including a plurality of client computers and a plurality of server computers, an apparatus for aggregating files among the client computers and the server computers, the apparatus collecting the use data while switching file messages among client and server computers.

26. The apparatus of claim 25, wherein a plurality of rules for aggregating files are derived from the use data.

27. The apparatus of claim 25, wherein the apparatus includes a plurality of rules for aggregating files, and at least one change to the plurality of rules is derived from the use data.

28. The apparatus of claim 27, wherein the at least one change is reflected in a second aggregating apparatus in the network.

29. In a network including a plurality of file aggregators, each aggregator aggregating files according to a plurality of rules, a method for changing the rules within the plurality of file aggregators, the method comprising:

changing the rules in a first aggregator;

the first aggregator forwarding the rule changes to the remaining plurality of file aggregators;

updating the rules in the remaining plurality of file aggregators.

30. In a computer network comprising a plurality of network participants, the participants comprising servers and clients, wherein file transactions flow among the network participants, an apparatus providing switching and aggregating of a single transaction among multiple network participants.

31. In a computer network comprising a plurality of network nodes, the nodes exchanging transactions having headers, a network node that switches file protocol transactions among other network nodes in a manner based upon information contained within transaction headers.

32. An apparatus for aggregating multiple servers in a network, the apparatus comprising means for aggregating network protocol transactions.

33. An apparatus for connecting a network client to a plurality of network servers, the apparatus comprising means for switching network file.